ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 01 | January - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PATTERN OF SKULL FRACTURES AND ASSOCIATED INTRACRANIAL HEMORRHAGES IN FATAL ROAD TRAFFIC ACCIDENTS IN DELHI.

Surgery

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ABSTRACT

Head injuries are a leading cause of death and disability in road traffic accidents. The pattern of skull fractures and associated intracranial hemorrhages can vary depending on the severity of the impact, the location of the impact, and the age and health of the victim. **Methods:** This study was a prospective analysis of 200 fatal road traffic accidents. The victims were all adults who died due to road traffic accident. The data was collected from medicolegal autopsies. **Results:** The most common type of skull fracture was a Linear fracture in 187 cases (93%). The temporal bone was the most commonly fractured bone in 39 (25%), followed by the parietal and temporal bone in 37cases (24%). The most common type of intracranial hemorrhage was subarachnoid hemorrhage in 191 cases (95%) followed by subdural hemorrhage in 178 cases (89%), **Conclusion:** The pattern of skull fractures and associated intracranial hemorrhages in fatal road traffic accidents is variable. However, Linear fractures of the temporal bone are the most common type of skull fracture, and subarachnoid hemorrhage is the most common type of intracranial hemorrhage. **Significance:** This study provides important information on the pattern of skull fractures and associated intracranial hemorrhages in fatal road traffic accidents. This information can be used to improve the diagnosis and management of head injuries in road traffic accidents.

KEYWORDS

Skull Fractures, Intracranial Hemorrhages, Road Traffic Accidents, Fatality, Pattern

INTRODUCTION

A road traffic accident (RTA) is any vehicular accident occurring on the roadway, between two or more objects one of which must be any kind of moving vehicle[1]. Head injuries are a major cause of morbidity and mortality in RTAs. The head is the most vulnerable part of the body in an RTA, and is often involved in serious injuries[2]. This is because the head contains the brain, a very important vital organ. Trauma to the head can cause a variety of injuries, including skull fractures, intracranial hemorrhages, and brain damage[3]. The occurrence, degree of deformation, and extent of fracture is not only related to the amount of strike power and the ratio of strike power to area of strike, but also to the physical properties of the skull at the point of contact, including thickness of scalp, amount of hair, and thickness and elasticity of the individual skull[4]. The extent and degree of injury to the skull and its content is not necessarily proportional to the quantum of force applied to the head[5]. Deaths from RTAs have been characterized worldwide as a hidden epidemic which affects all sectors of society[6]. Road traffic accidents cover almost two thirds of the total deaths due to head injuries, hence being the major devastating factor adding to total head traumas[7].

In India, there is a steep rise in vehicular accidents in the present era. Motorized two wheelers being economical are a very common mode of public transportation and are also responsible for a large number of accidents due to their easy loss of balance. Some of the factors that increase risks of RTA in India are inadequate traffic laws, drunken and rash driving, traffic accidents due to negligent act, poor conditions of the road, lack of infrastructures, mixed traffic, encroachments that restrict safe areas for pedestrian, and lack of valid driving licenses[8].

New Delhi is the capital city of India and still growing in every conceivable way leading to a sharp increase in educational establishments, roads, buildings, business, infrastructures, and population. The ratio of road area to total area of Delhi city is 21% as compared to 23% in London and 25% in Paris[9]. Total number of traffic accidents in Delhi in 2018 was 6515 in which 6086 people were injured and 1690 died[10]. North east Delhi is a congested part of Delhi having a national highway passing through it, large number of vehicles and roads in poor conditions leading to large number of vehicular accidents. This study is being conducted in North-east Delhi to study the association between cranial fractures and intracranial hemorrhages.

MATERIAL AND METHOD: -

The cross-sectional observational study was conducted at the Department of Forensic Medicine, University College of Medical Sciences and Guru Teg Bahadur Hospital, Delhi. from November 2018 to January 2020, for a period of 14 months. The study population consisted of adult deaths due to road traffic accidents brought for autopsy in the mortuary of Guru Teg Bahadur Hospital. This study was conducted to investigate the relationship between cranial fractures and intracranial hemorrhages in road traffic accidents. The study included adults who died due to head injury in a road traffic accident. The inclusion criteria were the presence of cranial fracture and intracranial hemorrhage. The exclusion criteria were adults with cranial fractures but no intracranial hemorrhages, crush injuries that distorted the head, cases with pathological disorders of the skull bones, injuries that occurred on the road without involvement of a vehicle, and injuries that occurred due to a fall from a stationary vehicle.

The skull and brain were dissected using the 'wet cutting' method taking serial coronal sections 1 cm apart. The intracranial hemorrhages present were noted. Data was entered in Microsoft excel and analyzed.

Ethical Considerations:

Informed consent was obtained from relatives of the deceased at the time of post-mortem examination. Ethical committee approval was obtained from Institutional Ethical Committee.

RESULTS:

The peak incidence of cases was in the age group of 21 to 30 years (26%) followed by 31 to 40 years (23.5%). Young adults (21 to 40 years) accounted for 49.5% of cases. Males comprised 88% of the cases, while females made up 12%. The male to female ratio was 7.33:1. Males followed the same age distribution pattern as the total cases, while females had the maximum number of deceased in the age group of 41-60 years.

Table 1: Age And Sex Distribution

AGE-GROUP (YRS)	MALE	FEMALES	TOTAL
18-20	12 (6%)	2 (1%)	14 (7%)
21-30	49 (24.5%)	3 (1.5%)	52 (26%)
31-40	43 (21.5)	4 (2%)	47 (23.5%)
41-50	28 (14%)	7 (3.5%)	35 (17.5%)
51-60	32 (16%)	7 (3.5%)	39 (19.5%)
61-100	12 (6%)	1 (0.5%)	13 (6.5%)

Among the different bones of the skull, the temporal bone was found to

be the most commonly fractured. Out of the 200 cases analyzed, 106 cases had linear fractures of the temporal bone alone, while in 5 cases, comminuted fractures of the temporal bone were observed alone or in combination with other bones. In total, 111 cases involved fractures of the temporal bone. The parietal bone was identified as the second most commonly fractured bone. In 87 cases, linear fractures of the parietal bone were present alone or in combination with other bones. Additionally, in 11 cases, comminuted fractures of the parietal bone were observed. Therefore, a total of 98 cases involved fractures of the parietal bone. The occipital bone was the third most commonly fractured bone, with 35 cases exhibiting linear fractures of the occipital bone alone or in combination with other bones. On the other hand, the frontal bone was found to be the least commonly fractured bone. In 31 cases, linear fractures of the frontal bone were present alone or in combination with other bones. Additionally, in 3 cases, comminuted fractures of the frontal bone were observed in combination with other bones. Thus, a total of 34 cases involved fractures of the frontal bone (Table 2).

Table2: Distribution Of Fractures Over Each Bone Over Vault

BONE	Linear	Comminuted	Total
FRONTAL	8	-	8
FRONTOPARIETAL	9	1	10
FRONTOTEMPORAL	1	-	1
FRONTO-PARIETO-OCCIPITAL	2	-	2
FRONTO-PARIETO-TEMPORAL	9	2	11
FRONTO-PARIETO-TEMPORO-OCCIPITAL	2	-	2
OCCIPITAL	6	-	6
PARIETAL	13	6	19
PARIETO-OCCIPITAL	7	-	7
PARIETO-TEMPORAL	37	2	39
PARIETO-TEMPORO-OCCIPITAL	8	-	8
TEMPORAL	39	1	40
TEMPORO-OCCIPITAL	10	-	10
TOTAL	151	12	163

Distribution Of Linear Fracture Over Base Of Skull

Out of a total of 200 cases, base of the skull fractures were observed in 157 cases, accounting for 78.5% of the total. Among these cases, exclusive fractures of the anterior cranial fossa were identified in 24 cases, while exclusive fractures of the middle cranial fossa were found in 37 cases. Additionally, exclusive fractures of the posterior cranial fossa were observed in 25 cases. A combination of fractures involving the anterior cranial fossa and middle cranial fossa was present in 40 cases. Moreover, a combination of fractures involving the anterior cranial fossa and posterior cranial fossa was found in 3 cases. Furthermore, a combination of fractures involving the middle cranial fossa and posterior cranial fossa was identified in 15 cases. Lastly, fractures involving all three regions, namely the anterior, middle, and posterior cranial fossa, were observed in 13 cases (Table 3).

A comminuted fracture on the right side of the middle cranial fossa was observed in one case, while a fracture on the right side of the posterior cranial fossa was identified in another case. Thus, the total number of cases with a comminuted fracture in the base of the skull amounted to two.

Table 3: Distribution Of Linear Fracture Over Base Of Skull

Region	Number of cases
ACF	24
MCF	37
PCF	25
ACF + MCF	40
ACF+PCF	3
MCF+PCF	15
ACF+MCF+PCF	13
TOTAL	157

* ACF = Anterior Cranial Fossa * MCF = Middle Cranial Fossa
*PCF = Posterior Cranial Fossa

Types Of Intracranial Hamorrhage

Among the 200 road traffic accident cases analyzed, subarachnoid hemorrhage was the most commonly observed type of hemorrhage, occurring in 191 cases (95.5%). This was followed by subdural hemorrhage, which was present in 178 cases (89%), and intracerebral hemorrhage, including hemorrhagic contusions, which was seen in 167 cases (83.5%). On the other hand, extradural hemorrhage was the least frequently observed, occurring in 30 cases (15%).

It is important to note that subdural hemorrhage and subarachnoid hemorrhage were the only types of hemorrhages that were exclusively found. In three cases, subarachnoid hemorrhage was exclusively present, while in only one case, subdural hemorrhage was exclusively observed. Extradural hemorrhage and intracerebral hemorrhage, on the other hand, were not exclusively found in any of the cases.

When considering the combination of different types of hemorrhage, the most commonly observed combination was a combination of subarachnoid, subdural, and intracranial hemorrhage, which was present in 123 cases (61.5%). The second most common combination was a combination of subarachnoid and subdural hemorrhage, which was seen in 24 cases (12%) (Table 4).

Table 4: Distribution Of Intracranial Haemorrhages

TYPE OF HAEMORRHAGE	NUMBER	PERCENTAGE
SAH ONLY	3	1.5
SDH ONLY	1	0.5
SDH + SAH	24	12
SAH + ICH	14	07
SDH + ICH	5	2.5
SAH + SDH + ICH	123	61.5
EDH + SAH	1	0.5
EDH + SDH	1	0.5
EDH + SAH + ICH	2	01
EDH + ICH	2	01
EDH + SAH + SDH	3	1.5
EDH + SAH + SDH + ICH	21	10.5
TOTAL	200	100

*EDH= Extradural Haemorrhage *ICH= Intra Cerebral Haemorrhage
*SAH= Subarachnoid Haemorrhage *SDH= Subdural Haemorrhage

Table 5: Association of intracranial hemorrhages with fracture.

Intracranial hemorrhage	No. of cases with Linear fractures	No. of cases with comminuted fractures	Total
Extradural hemorrhage	27	3	30
Subdural hemorrhage	166	12	178
Sub Arachnoid hemorrhage	178	13	191
Intraventricular hemorrhage(IVH)/ Intra cerebral hemorrhage (ICH)	156	11	167

In our study of 200 cases, 187 exhibited linear fractures of the skull, while 13 had comminuted fractures. Among the linear fracture cases, 27 cases (14.43%) had extradural hemorrhage, 166 cases (88.77%) had subdural hemorrhage, 178 cases (95.18%) had subarachnoid hemorrhage, and 156 cases (83.42%) had intracerebral hemorrhage. In contrast, among the comminuted fracture cases, 3 cases (23.07%) had extradural hemorrhage, 12 cases (92.30%) had subdural hemorrhage, 13 cases (100%) had subarachnoid hemorrhage, and 11 cases (84.61%) had intracerebral hemorrhage.(Table 5)

DISCUSSION

Accidents are a serious global health problem, particularly due to factors like fast-moving vehicular traffic, urbanization, and changing social patterns. Despite safety improvements, accidents remain a pervasive hazard, affecting people of all ages and regions. Developing countries face increasing road traffic deaths. Head injuries from motor vehicle accidents, especially among youth and middle-aged individuals, contribute significantly to global health burdens. In India, road traffic accidents continue to be the leading cause of morbidity and mortality, with a high number of fatalities resulting from head injuries.

Type of skull fractures:

In various studies, including those conducted by Menon A et al[1], Chavan KD et al[8], Shivkumar BC et al[12], Devraj[13], Das RK et al[14], Kumar S et al[15], Akhade SP et al[16], Venkateswarrao S et al[17], Bharathi OM et al[18], Umbare et al[19], Nair SS et al[20], and Das NK et al[21], it was consistently found that linear fractures of the skull were the most common type of fracture. The prevalence of linear fractures ranged from 31.7% to 77%, with the present study reporting 93.5% of cases having linear fractures. Comminuted fractures were less frequent, ranging from 7.37% to 32.25%, with the present study reporting 6.5% of cases. These findings highlight the high occurrence of linear fractures and provide further support for the prevalence of this type of fracture in different studies.

Intracranial hemorrhages:

The distribution of hemorrhages among different studies revealed varying patterns. In the present study, subarachnoid hemorrhage (SAH) was the most common type, followed by subdural hemorrhage (SDH), while extradural hemorrhage (EDH) was the least commonly observed. These findings were consistent with the studies conducted by Akhade SP et al[16], Nair SS et al[20], Mohan M et al[22], and Venkatesaprasanna J et al[23]. Conversely, studies conducted by Menon A et al[11], Menon A et al[24], Shivkumar BC et al[12], Honnungar RS et al[6], Surendar J et al[25], Mahender G et al[26], Umbare RB et al[19], Gupta A et al[27], and Pendro TS et al[28] reported that SDH was the most common, followed by SAH. Overall, extradural hemorrhage was uncommon in road traffic accidents, while the incidence of subarachnoid and subdural hemorrhages was more or less equal, with subarachnoid hemorrhage being slightly more prevalent.

CONCLUSION:

In conclusion, this study aimed to investigate the pattern of skull fractures and associated intracranial hemorrhages in cases of road traffic accidents. The study included 200 cases, all of which exhibited skull fractures with associated intracranial hemorrhages. The findings revealed several epidemiological factors, including a male predominance, with a male-to-female ratio of 7.33:1. The peak incidence of cases occurred in the third and fourth decades of life. Linear fractures of the skull were the most common type, while comminuted fractures were less frequent. In most cases, both the skull vault and base of the skull were fractured. The temporal bone was the most commonly fractured bone, followed by the parietal bone, with the frontal bone being the least commonly fractured. In cases involving base of skull fractures, the middle cranial fossa was the most commonly affected. The combination of subarachnoid hemorrhage, subdural hemorrhage, and intracerebral hemorrhage was frequently observed. Subarachnoid hemorrhage was the most common type of hemorrhage found, followed by subdural hemorrhage. The study emphasizes the importance of prompt transportation of road traffic accident victims to hospitals, as the survival time for head injuries is often less than 12 hours. Strict enforcement of helmet usage for two-wheeler drivers is crucial in preventing head injuries.

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